Summary Report

2013 Water Loss Control Audit for Security Water District

September 15, 2014

Funding Provided by Colorado Water Conservation Board

Water Efficiency Grant PO OE PDA 14000000074

Prepared by:

WaterDM DEMAND MANAGEMENT

Water Matters!

WSO

Introduction

The goal of this project was to use the IWA/AWWA Water Audit Method published in the AWWA Manual of Practice M36 to conduct the first "top down approach" desktop water audit for the Security Water District (District). The preliminary audit was developed ty District staff in conjunction with WaterDM and Water Matters! The results of the desktop audit were reviewed by international water loss expert Reinhard Sturm of WSO.

This summary report and the completed water audit spreadsheet constitute the final deliverables for this project.

Security Water District

Security Water District was established in 1954 as a quasi-municipal corporation and political subdivision of the State of Colorado for the purpose of providing water improvements and services for its residents, which currently number about 18,500. The District is located in an area of unincorporated El Paso County bordered on the north by Drennan Road/Proby Parkway, on the west by I-25, on the east by Grinnel Road and on the south by Fontaine Blvd. The District comprises approximately five square miles.

Security obtains its water supply from the Frying Pan-Arkansas Project by way of the Fountain Valley Authority and from 20 groundwater wells located in the Widefield and Windmill Gulch aquifers. About 2/3 of the current supply comes from groundwater, the remaining 1/3 from Project surface water. Its groundwater is alluvial, therefore subject to various augmentation agreements. This mix is expected to change in the future, ultimately increasing dependence on surface water.

Although the District enjoys an adequate supply of water, sufficient to meet the needs of its current growth well into the future, it experiences an average of 10 to 12 percent "non-revenue" water loss, and is anxious to determine the cause of this loss.

Working with Linda Firth of Water Matters! and Peter Mayer, P.E. of WaterDM, the District obtained a water efficiency implementation grant from the Colorado Water Conservation Board (CWCB) for conducting the water loss control audit and expert review.

Water Loss Audit

Peter Mayer and Linda Firth met with Security Water District on February 7, 2014 to learn more about their non-revenue water concerns; to establish project goals and timelines; and to begin the data gathering process. We gave Security a list of data needed to begin our analysis, using the AWWA M36 method.

The audit team met again with Security Water District on February 12. The water loss control audit data input process was completed, and few gaps and uncertainties were identified. Using the AWWA M36 methodology, the team identified three areas for further investigation and analysis. These were imported water (inability to verify Fountain Valley Authority's measurement accuracy without further investigation); volume from own sources; and systematic data handling errors.

Next the audit team held a phone discussion with Reinhard Sturm of Water System Optimization (WSO) to discuss the audit results, clarify issues, and revise the reporting worksheet responses. A revised audit spreadsheet was provided to the District and the project was put on hiatus for several months to allow the Town of Monument to catch up so that the in-person visit from Reinhard Sturm could be coordinated at a convenient time.

On September 4, Reinhard Sturm, Peter Mayer, and Linda Firth met again with Roy Heald and District staff to review and finalize the water loss control audit. On September 5, the Team conducted a water loss control workshop at the Water Research Foundation facility at 6666 West Quincy Ave. in Denver. The workshop was led by Reinhard Sturm and Kate Gasner of WSO, assisted by Peter Mayer and Linda Firth.

Findings from 2013 Water Audit

The 2013 water loss control audit for the Security Water District found that approximately 110 million gallons of water are lost from the system each year. About 12 million gallons are apparent losses and 98 million gallons are real losses. It is estimated that in Security's water system about 46 million gallons per year of loss is unavoidable suggesting that about 66 million gallons of loss could be addressed through future action.

Real water losses in the district amount to 36.5 gallons per connection to day. This could probably be brought down to 20 gallons per connection per day over time through a systematic water loss control program. It is calculated that in 2013, the annual cost of the Apparent Losses in the system was $36,030 and the annual cost of Real losses to the system was $169,995.

2013 Water Loss Control Performance Indicators

Financial Indicators

- $35,030 – Annual cost of Apparent losses
- $169,965 – Annual cost of Real losses (valued at the variable production cost - $1,731.60 per MG)
- 12.5% - Non-revenue water as percent by volume of water supplied.
- 6.5% - Non revenue water as percent by cost of operating water system

Operational Efficiency

- Apparent losses per service connection – 4.4 gal/connect/day
- Real losses per service connection per day – 36.5 gal/connect/day
- Current Real Annual Losses – 98.15 million gallons/year
- Infrastructure Leakage Index (ILI) – 2.14

The ILI is a performance indicator for comparing utilities operational management of real losses. An ILI score of in the range of 1-3 is a general indication that water is expensive to deliver and there is limited ability to increase revenue through rates. Supplies are limited and difficult or environmentally unsound to develop. Because of this, operating with a system leakage level above 2013 levels is not recommended. A path of steady water accountability and improvement is recommended.

Water Audit Data Validity Score

Security received a 76 out of 100 Water Audit Data Validity Score for their first Water Audit. A score of 76 is quite a good level of overall water accountability, particularly for a first audit. This score can be improved by implementing as many of the recommendations described below

as possible and by reviewing the data validating requirements in the AWWA software (v5.0) provided.

Recommendations from 2013 Water Audit

Based on discussions with Roy Heald and District staff, it appears that water loss and system leaks have been fairly consistent through the years. This suggests that leak detection could be carried out in phases up to the annual economic level of water loss discussed above.

The following recommendations for Security were made by Reinhard Sturm of WSO during the September 4, 2014 meeting:

- Consider independent calibration of Security's well meters and the meters supplying Security that belong to the Fountain Valley Authority (FVA). This calibration will improve understanding of the accuracy of these source water meters and will improve accountability.
    - Work to obtain better information and accuracy reports from the Fountain Valley Authority regarding their supply meters. One of these supply meters is currently a differential pressure (i.e. Venturi) type of meter of unknown age, accuracy. The testing history of all FVA meters is unknown.
    - Request addition of an insertion meter or a permanently installed water meter to provide independent measurements of FVA meters.
- To improve the data validity score of the "Billed metered" category of future water audits, an independent verification of the customer billing data is recommend. This "audit" of the database searches for inconsistencies and verifies volume measurements for the water audit.
- Meters will deteriorate over time and with use. Within 2 years, Security should pull a small random sample of 20 – 30 meters and test them for accuracy at low, medium, and high flow regimes. Based on the results on those tests the District should develop a rational meter replacement program.

2013 Water Loss Control Audit Summary

A summary of the data input and outputs from the 2013 Security WaterDistrict water loss control audit is presented here.

WATER SUPPLIED		
Volume from own sources:	623.326	MG/Yr
Water imported:	331.480	MG/Yr
Water exported:		MG/Yr
WATER SUPPLIED:	**954.806**	MG/Yr
AUTHORIZED CONSUMPTION		
Billed metered:	835.140	MG/Yr
Billed unmetered:		MG/Yr
Unbilled metered:	1.142	MG/Yr
Unbilled unmetered:	8.535	MG/Yr
AUTHORIZED CONSUMPTION:	**844.817**	MG/Yr
WATER LOSSES (Water Supplied - Authorized Consumption)	**109.989**	MG/Yr
Apparent Losses		
Unauthorized consumption:	2.387	MG/Yr
Customer metering inaccuracies:	8.447	MG/Yr
Systematic data handling errors:	1.000	MG/Yr
Apparent Losses:	**11.834**	MG/Yr
Real Losses = Water Losses - Apparent Losses:	**98.155**	MG/Yr
WATER LOSSES:	**109.989**	MG/Yr

NON-REVENUE WATER

NON-REVENUE WATER: **119.666** MG/Yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	101.0	miles
Number of active AND inactive service connections:	7,368	
Service connection density:	73	conn./mile main
Average length of customer service line:	60.0	ft
Average operating pressure:	55.0	psi

COST DATA

Total annual cost of operating water system:	$3,430,431	$/Year
Customer retail unit cost (applied to Apparent Losses):	$2.96	$/1000 gallons (US)
Variable production cost (applied to Real Losses):	$1,731.60	$/Million gallons

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Summary Report

2014 Water Loss Control Audit for Security Water District

September 1,, 2015

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Introduction

The goal of this project was to use the IWA/AWWA Water Audit Method published in the AWWA Manual of Practice M36 to conduct the second "top down approach" desktop water audit for the Security Water District (District). The preliminary 2013 audit was developed by District staff in conjunction with WaterDM and Water Matters!. The results of the desktop audit were reviewed by international water loss expert Reinhard Sturm of WSO. The 2014 audit was completed by District staff, WaterDM and Water Matters!.

This summary report and the completed water audit spreadsheet constitute the final deliverables for this project.

Security Water District

Security Water District was established in 1954 as a quasi-municipal corporation and political subdivision of the State of Colorado for the purpose of providing water improvements and services for its residents, which currently number about 19,000. The District is located in an area of unincorporated El Paso County bordered on the north by Drennan Blvd., on the west by I-25, on the east by Grinnel Road and on the south by Fontaine Blvd. The District comprises approximately five square miles.

Security obtains its water supply from the Frying Pan-Arkansas Project by way of the Fountain Valley Authority and from 20 groundwater wells located in the Widefield and Windmill Gulch aquifers. About 2/3 of the current supply comes from groundwater, the remaining 1/3 from Project surface water. Its groundwater is alluvial, therefore subject to various augmentation agreements. This mix is expected to change in the future, ultimately increasing dependence on surface water.

Although the District enjoys an adequate supply of water, sufficient to meet the needs of its current growth well into the future, it experiences an average of 10 to 12 percent "non-revenue" water loss, and is anxious to determine the cause of this loss.

Working with Linda Firth of Water Matters! and Peter Mayer, P.E. of WaterDM, the District obtained a water efficiency implementation grant from the Colorado Water Conservation Board (CWCB) for conducting the 2013 water loss control audit and expert review. The grant budget was sufficient to extend to project to also include the 2014 water loss control audit.

2014 Water Loss Audit

Peter Mayer and Linda Firth met with Security Water District on August 13, 2015 to obtain data and conduct the basic water loss audit using the AWWA M36 method and software.

Findings from 2014 Water Audit

The 2014 water loss control audit for the Security Water District found that approximately 90.8 million gallons of water were lost from the system, a substantial reduction from 2013. About 11.9 million gallons are apparent losses and 79.8 million gallons are real losses. It is estimated that in Security's water system about 47.9 million gallons per year of loss is unavoidable suggesting that about 42.9 million gallons of loss could be addressed through future action.

Real water losses in the district in 2014 amounted to 28.9 gallons per connection to day, a 20% reduction over 2013. Over time, this volume of loss could probably be brought down to 20 gallons per connection per day through a systematic water loss control program. It is calculated that in 2014, the annual cost of the Apparent Losses in the system was $39,982 and the annual cost of Real losses to the system was $136,569.

2014 Water Loss Control Performance Indicators

Financial Indicators

- $39,982 – Annual cost of Apparent losses
- $136,569 – Annual cost of Real losses (valued at the variable production cost - $1,731.60 per MG)
- 10.5% - Non-revenue water as percent by volume of water supplied.
- 5.8% - Non revenue water as percent by cost of operating water system

Operational Efficiency

- Apparent losses per service connection – 4.4 gal/connect/day
- Real losses per service connection per day – 28.9 gal/connect/day
- Current Real Annual Losses – 78.9 million gallons/year
- Infrastructure Leakage Index (ILI) – 1.65

The ILI is a performance indicator for comparing utilities operational management of real losses. An ILI score of in the range of 1-3 is a general indication that a utility is doing a good job managing water loss but understands that water is expensive to deliver and there is limited ability to increase revenue through rates. Supplies are limited and difficult or environmentally unsound to develop.

Water Audit Data Validity Score

Security received a 73 out of 100 Water Audit Data Validity Score for their first Water Audit. A score of 73 is an acceptable level of overall water accountability. This score can be improved by implementing as many of the recommendations described below as possible and by reviewing the data validating requirements in the AWWA software (v5.0) provided.

Comparing 2013 and 2014 Water Audits

A comparison of results from the 2013 and 2014 water loss audits for Security is shown in Table 1. Water loss was 17.5% lower in 2014 than 2013 as the volume of water supplied was less and the authorized consumption was higher. It is uncertain what brought about this reduction, but Security staff hypothesized that it could be related to the replacement of one or more large, old water meters with new more accurate models.

Security's overall Infrastructure Leakage Index, an overall evaluation of water loss and management in the system improved from 2.1 in 2013 to 1.6 in 2014. This indicates a substantial overall improvement in the essential water loss metrics.

Table 1: Comparison of 2013 and 2014 M36 Water Audits

Report Year	2013	2014
Reporting Period	1/1/2013 - 12/31/2013	1/1/2014 - 12/31/2014
Audit Prep Date	9/5/2014	9/13/2015
Units	Million gallons (US)	Million gallons (US)
Volume From Own Sources	623.33	940.96
Water Imported	331.48	
Water Supplied	**954.81**	**940.96**
Billed Metered	**835.14**	**841.70**
Unbilled Metered	1.14	4.44
Unbilled Unmetered	8.54	4.00
Authorized Consumption	**844.82**	**850.14**
Water Losses	**109.99**	**90.82**
Unauthorized Consumption	2.39	2.35
Customer Metering Inaccuracies	8.45	8.55
Apparent Losses	**11.83**	**11.90**
Real Losses	**98.15**	**78.92**
Non Revenue Water	**119.67**	**99.26**
Length of Mains	101	115
Number of Active and Inactive Service Connections	7368	7493
Service Connection Density	72.95	65.16
Average length of customer service line	60	60
Average Operating Pressure	55	55
Total Annual Cost of Operating Water System	$ 3,430,431	$3,307,498
Customer Retail Unit Cost	$ 2.96	$ 3.36
Customer Retail Units	$/1000 gallons (US)	$/1000 gallons (US)

Report Year	2013	2014
Variable Production Cost	$ 1,731.60	$1,731.60
Unavoidable Annual Real Losses (UARL)	45.76	47.87
Annual Cost of Apparent Losses	$ 35,030	$39,982
Annual Cost of Real Losses	$ 169,965	$136,659
Value Applied to Real Losses (VPC / CRUC)	VPC	VPC
Non-Revenue Water as % by Volume of Water Supplied	12.5%	10.5%
Non-Revenue Water as % by Cost of Operating System	6.5%	5.8%
Apparent Losses per service connection per day	4.4	4.4
Real Losses per service connection per day	36.5	28.9
Real Losses per service connection per day per unit pressure	0.7	0.5
Current Annual Real Losses (CARL)	98.2	78.9
Infrastructure Leakage Index (ILI)	**2.1**	**1.6**
Water Audit Data Validity Score	76	73

Recommendations from 2014 Water Audit

Based on two years of audit data and discussions with Roy Heald and District staff regarding previous years, it appears that water loss and system leaks have been fairly consistent through the years. The 2014 AWWA M6 water audit indicates improvement over 2013. This suggests that Security's on-going practices are effective and should be continued, – including regular water meter replacement and testing programs.

To reduce water loss in the future, leak detection and repair work could be carried out in phases up to the annual economic level of water loss.

The following specific recommendations are made to Security:

- Continue to perform annual AWWA water audits and to track performance over time which will help inform future decision about where best to invest time and effort in reducing water losses.
- The 2014 audit shows improvement over 2013, even though no specific actions were taken to address water loss. In the future, more concrete actions may be necessary to maintain low levels of water loss.

- Consider independent calibration of Security's well meters and the meters supplying Security that belong to the Fountain Valley Authority (FVA). This calibration will improve understanding of the accuracy of these source water meters and will improve accountability.
    - Work to obtain better information and accuracy reports from the Fountain Valley Authority regarding their supply meters. One of these supply meters is currently a differential pressure (i.e. Venturi) type of meter of unknown age, accuracy. The testing history of all FVA meters is unknown.
    - Request addition of an insertion meter or a permanently installed water meter to provide independent measurements of FVA meters.
- To improve the data validity score of the "Billed metered" category of future water audits, an independent verification of the customer billing data is recommend. This "audit" of the database searches for inconsistencies and verifies volume measurements for the water audit.
- Meters will deteriorate over time and with use. Within 2 years, Security should pull a small random sample of 20 – 30 meters and test them for accuracy at low, medium, and high flow regimes. Based on the results on those tests the District should develop a rational meter replacement program.
- Water loss in Security appears reasonably consistent month to month, suggesting a steady amount leakage in the system which could potentially be detected and repaired. Security could consider contracting with a qualified professional water loss control firm to listen to all lines, valves, and service connections for leaks.

2014 Water Loss Control Audit Summary

A summary of the data input and outputs from the 2014 Security Water District water loss control audit is presented here.

WATER SUPPLIED		
Volume from own sources:	940.963	MG/Yr
Water imported:		MG/Yr
Water exported:		MG/Yr
WATER SUPPLIED:	**940.963**	MG/Yr
AUTHORIZED CONSUMPTION		
Billed metered:	841.704	MG/Yr
Billed unmetered:		MG/Yr
Unbilled metered:	4.439	MG/Yr
Unbilled unmetered:	4.000	MG/Yr
AUTHORIZED CONSUMPTION:	**850.143**	MG/Yr

WATER LOSSES (Water Supplied - Authorized Consumption)	**90.820**	MG/Yr
Apparent Losses		
Unauthorized consumption:	2.352	MG/Yr
Customer metering inaccuracies:	8.547	MG/Yr
Systematic data handling errors:	1.000	MG/Yr
Apparent Losses:	**11.899**	MG/Yr
Real Losses = Water Losses - Apparent Losses:	**78.921**	MG/Yr
WATER LOSSES:	**90.820**	MG/Yr

NON-REVENUE WATER

NON-REVENUE WATER: **99.259** MG/Yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	115.0	miles
Number of active AND inactive service connections:	7,493	
Service connection density:	65	conn./mile main
Average length of customer service line:	60.0	ft
Average operating pressure:	55.0	psi

COST DATA

Total annual cost of operating water system:	$3,307,498	$/Year
Customer retail unit cost (applied to Apparent Losses):	$3.36	$/1000 gallons (US)
Variable production cost (applied to Real Losses):	$1,731.60	$/Million gallons

2014 Water Balance

AWWA Free Water Audit Software: Water Balance

WAS v5.0

Water Audit Report for:	Security Water Districts	
Reporting Year:	2014	12/2013 - 12/2014
Data Validity Score:	73	

Own Sources (Adjusted for known errors) 940.963	Water Exported 0.000	Billed Water Exported			
	Water Supplied 940.963	Authorized Consumption 850.143	Billed Authorized Consumption 841.704	Billed Metered Consumption (water exported is removed) 841.704	Revenue Water 841.704
				Billed Unmetered Consumption 0.000	
			Unbilled Authorized Consumption 8.439	Unbilled Metered Consumption 4.439	Non-Revenue Water (NRW) 99.259
				Unbilled Unmetered Consumption 4.000	
		Water Losses 90.820	Apparent Losses 11.899	Unauthorized Consumption 2.352	
				Customer Metering Inaccuracies 8.547	
				Systematic Data Handling Errors 1.000	
Water Imported 0.000			Real Losses 78.921	Leakage on Transmission and/or Distribution Mains Not broken down	
				Leakage and Overflows at Utility's Storage Tanks Not broken down	
				Leakage on Service Connections Not broken down	

2014 Performance Indicators

AWWA Free Water Audit Software:
System Attributes and Performance Indicators

WAS v5.0

Water Audit Report for: Security Water Districts
Reporting Year: 2014 | 12/2013 - 12/2014

*** YOUR WATER AUDIT DATA VALIDITY SCORE IS: 73 out of 100 ***

System Attributes:

	Apparent Losses:	11.899	MG/Yr
+	Real Losses:	78.921	MG/Yr
=	Water Losses:	90.820	MG/Yr
	? Unavoidable Annual Real Losses (UARL):	47.87	MG/Yr
	Annual cost of Apparent Losses:	$39,982	
	Annual cost of Real Losses:	$136,659	Valued at Variable Production Cost

Return to Reporting Worksheet to change this assumpiton

Performance Indicators:

Financial:	Non-revenue water as percent by volume of Water Supplied:	10.5%	
	Non-revenue water as percent by cost of operating system:	5.8%	Real Losses valued at Variable Production Cost
Operational Efficiency:	Apparent Losses per service connection per day:	4.35	gallons/connection/day
	Real Losses per service connection per day:	28.86	gallons/connection/day
	Real Losses per length of main per day*:	N/A	
	Real Losses per service connection per day per psi pressure:	0.52	gallons/connection/day/psi
	From Above, Real Losses = Current Annual Real Losses (CARL):	78.92	million gallons/year
	? Infrastructure Leakage Index (ILI) [CARL/UARL]:	1.65	

* This performance indicator applies for systems with a low service connection density of less than 32 service connections/mile of pipeline

Contact Information

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Water Matters!

Summary Report

2016 Water Loss Control Audit for Security Water District

April 14, 2017

Funding Provided by Colorado Water Conservation Board

Water Efficiency Grant PO OE PDA 14000000074

Prepared by:

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DEMAND MANAGEMENT

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This summary report and the completed water audit spreadsheet constitute the final deliverables for this project.

Security Water District

Security Water District was established in 1954 as a quasi-municipal corporation and political subdivision of the State of Colorado for the purpose of providing water improvements and services for its residents, which currently number about 19,000. The District is located in an area of unincorporated El Paso County bordered on the north by Drennan Blvd., on the west by I-25, on the east by Grinnel Road and on the south by Fontaine Blvd. The District comprises approximately five square miles.

Security has historically obtained its water supply from the Frying Pan-Arkansas Project by way of the Fountain Valley Authority and from 20 groundwater wells located in the Widefield and Windmill Gulch aquifers. In May 2016, the EPA announced it was tightening drinking water health advisory levels for Perfluoroalkyl substances (PFASs). Tests revealed that drinking water from groundwater sources in Security, Widefield, and Fountain had among the highest levels of PFASs in the US. This was a serious issue because in 2015, about 2/3 of Security's water supply came from groundwater.

In July 2016, Security began construction of piping that allowed better circulation of uncontaminated surface water from Pueblo Reservoir into impacted areas. At the same time, Security Water District and Colorado Springs Utilities agreed to increase the amount of surface water delivered to Security through the Southern Delivery System (SDS). SDS starting operations in April 2016 could not have come at a more fortuitous time. Security participated in SDS to improve system reliability and that investment paid off immediately. Security is currently relying entirely on SDS water.

The entity responsible for the PFAS contamination, the US Airforce, has agreed to install granular activated carbon filters to treat Security's groundwater in the future. Once these treatment processes are working, it should allow for the use of groundwater again. In the meantime, SDS water remains available.

These dramatic changes in water source and supply were discussed as part of the 2016 water loss audit.

Working with Linda Firth of Water Matters! and Peter Mayer, P.E. of WaterDM, the District obtained a water efficiency implementation grant from the Colorado Water Conservation Board (CWCB) for conducting the 2013 water loss control audit and expert review. The grant budget was sufficient to extend to project to also include the 2014 and 2016 water audits.

2016 Water Loss Audit

Peter Mayer and Linda Firth met with Security Water District on April 7, 2017 to obtain data and conduct the basic water loss audit using the AWWA M36 method and software.

Findings from 2016 Water Audit

The 2016 water loss control audit for the Security Water District found that approximately 108 million gallons of water were lost from the system, quite similar to the level of loss in 2013, but higher than 2014. About 11.5 million gallons are apparent losses and 96.7 million gallons are real losses. It is estimated that in Security's water system about 48.3 million gallons per year of loss is unavoidable suggesting that about 48.4 million gallons of loss could be addressed through future action.

Real water losses in the district in 2016 amounted to 35.1 gallons per connection to day. Over time, this volume of loss could probably be brought down to 20 gallons per connection per day through a systematic water loss control program. It is calculated that in 2016, the annual cost of the Apparent Losses in the system was $38,570and the annual cost of Real losses to the system was $167,416.

2016 Water Loss Control Performance Indicators

Financial Indicators

- $38,570 – Annual cost of Apparent losses
- $167,416 – Annual cost of Real losses (valued at the variable production cost - $1,731.60 per MG)
- 12.7% - Non-revenue water as percent by volume of water supplied.
- 4.6% - Non revenue water as percent by cost of operating water system

Operational Efficiency

- Apparent losses per service connection – 4.2 gal/connect/day
- Real losses per service connection per day – 35.1 gal/connect/day
- Current Real Annual Losses – 96.7 million gallons/year
- Infrastructure Leakage Index (ILI) – 2.01

The ILI is a performance indicator for comparing utilities operational management of real losses. An ILI score of in the range of 1-3 is a general indication that a utility is doing a good job managing water loss but understands that water is expensive to deliver and there is limited ability to increase revenue through rates. Supplies are limited and difficult or environmentally unsound to develop.

Water Audit Data Validity Score

Security received a 73 out of 100 Water Audit Data Validity Score for their third Water Audit. A score of 73 is an acceptable level of overall water accountability. This score can be improved by implementing as many of the recommendations described below as possible and by reviewing the data validating requirements in the AWWA software (v5.0) provided.

Comparing 2013, 2014, and 2016 Water Audits

A comparison of results from the 2013, 2014 and 2016 water loss audits for Security is shown in Table 1.

Table 1: Comparison of M36 Water Audits

Report Year	2013	2014	2016
Reporting Period	1/1/2013 - 12/31/2013	1/1/2014 - 12/31/2014	1/1/2016 - 12/31/2016
Audit Prep Date	9/5/2014	9/13/2015	4/7/2017
Units	Million gallons (US)	Million gallons (US)	Million gallons (US)
Volume From Own Sources	623.33	940.96	921.52
Water Imported	331.48		
Water Supplied	**954.81**	**940.96**	**921.52**
Billed Metered	**835.14**	**841.70**	**804.39**
Unbilled Metered	1.14	4.44	4.96
Unbilled Unmetered	8.54	4.00	4.0
Authorized Consumption	**844.82**	**850.14**	**813.36**
Water Losses	**109.99**	**90.82**	**108.16**
Unauthorized Consumption	2.39	2.35	2.30
Customer Metering Inaccuracies	8.45	8.55	8.18
Apparent Losses	**11.83**	**11.90**	**11.48**
Real Losses	**98.15**	**78.92**	**96.68**
Non Revenue Water	**119.67**	**99.26**	**117.13**
Length of Mains	101	115	115

Report Year	2013	2014	2016
Number of Active and Inactive Service Connections	7368	7493	7547
Service Connection Density	72.95	65.16	66
Average length of customer service line	60	60	60
Average Operating Pressure	55	55	55
Total Annual Cost of Operating Water System	$ 3,430,431	$3,307,498	$4,772,297
Customer Retail Unit Cost	$ 2.96	$ 3.36	$3.36
Customer Retail Units	$/1000 gallons (US)	$/1000 gallons (US)	$/1000 gallons (US)
Variable Production Cost	$ 1,731.60	$1,731.60	$1,731.60
Unavoidable Annual Real Losses (UARL)	45.76	47.87	48.13
Annual Cost of Apparent Losses	$ 35,030	$39,982	$38,570
Annual Cost of Real Losses	$ 169,965	$136,659	$167,416
Value Applied to Real Losses (VPC / CRUC)	VPC	VPC	VPC
Non-Revenue Water as % by Volume of Water Supplied	12.5%	10.5%	12.7%
Non-Revenue Water as % by Cost of Operating System	6.5%	5.8%	4.6%
Apparent Losses per service connection per day	4.4	4.4	4.2
Real Losses per service connection per day	36.5	28.9	35.1
Real Losses per service connection per day per unit pressure	0.7	0.5	0.6
Current Annual Real Losses (CARL)	98.2	78.9	96.7
Infrastructure Leakage Index (ILI)	**2.1**	**1.6**	**2.0**
Water Audit Data Validity Score	76	73	73

Recommendations from 2016 Water Audit

Based on three years of audit data and discussions with Roy Heald and District staff regarding previous years, it appears that water loss and system leaks fluctuate, but have been fairly consistent through the years. The 2016 AWWA M6 water audit bears this out. Security's on-going practices are effective and should be continued, – including regular water meter replacement and testing programs.

To reduce water loss in the future, leak detection and repair work could be carried out in phases up to the annual economic level of water loss.

The following specific recommendations are made to Security:

- Continue to perform annual AWWA water audits and to track performance over time which will help inform future decision about where best to invest time and effort in reducing water losses.
- The 2016 audit shows higher loss than 2014, but about the same as 2013. As the Security water system ages, concrete actions may be necessary to maintain low levels of water loss.
- Consider independent calibration of Security's well meters and the meters supplying Security that belong to the Fountain Valley Authority (FVA). This calibration will improve understanding of the accuracy of these source water meters and will improve accountability.
- To improve the data validity score of the "Billed metered" category of future water audits, an independent verification of the customer billing data is recommend. This "audit" of the database searches for inconsistencies and verifies volume measurements for the water audit.
- Meters will deteriorate over time and with use. Within 2 years, Security should pull a small random sample of 20 – 30 meters and test them for accuracy at low, medium, and high flow regimes. Based on the results on those tests the District should develop a rational meter replacement program.
- Water loss in Security appears reasonably consistent month to month, suggesting a steady amount leakage in the system which could potentially be detected and repaired. Security could consider contracting with a qualified professional water loss control firm to listen to all lines, valves, and service connections for leaks.

2016 Water Loss Control Audit Summary

A summary of the data input and outputs from the 2016 Security Water District water loss control audit is presented here.

WATER SUPPLIED			
Volume from own sources:	921.522	MG/Yr	
Water imported:		MG/Yr	
Water exported:		MG/Yr	
WATER SUPPLIED:	**921.522**	MG/Yr	
AUTHORIZED CONSUMPTION			
Billed metered:	804.395	MG/Yr	
Billed unmetered:		MG/Yr	
Unbilled metered:	4.965	MG/Yr	
Unbilled unmetered:	4.000	MG/Yr	
AUTHORIZED CONSUMPTION:	**813.360**	MG/Yr	
WATER LOSSES (Water Supplied - Authorized Consumption)		**108.162**	MG/Yr
Apparent Losses			
Unauthorized consumption:		2.304	MG/Yr
Customer metering inaccuracies:		8.175	MG/Yr
Systematic data handling errors:		1.000	MG/Yr
Apparent Losses:		**11.479**	MG/Yr
Real Losses = Water Losses - Apparent Losses:		**96.683**	MG/Yr
WATER LOSSES:		**108.162**	MG/Yr

NON-REVENUE WATER

NON-REVENUE WATER: **117.127** MG/Yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	115.0	miles
Number of active AND inactive service connections:	7,547	
Service connection density:	65	conn./mile main
Average length of customer service line:	60.0	ft
Average operating pressure:	55.0	psi

COST DATA

Total annual cost of operating water system:	$4,772,297	$/Year
Customer retail unit cost (applied to Apparent Losses):	$3.36	$/1000 gallons (US)
Variable production cost (applied to Real Losses):	$1,731.60	$/Million gallons

2016 Water Balance

AWWA Free Water Audit Software: Water Balance

WAS v5.0

American Water Works Association.

Water Audit Report for:	Security Water Districts	
Reporting Year:	2016	12/2015 - 12/2016
Data Validity Score:	73	

Water Exported *0.000*

Billed Water Exported

Own Sources (Adjusted for known errors) *921.522*

Water Supplied *921.522*

Water Imported *0.000*

Authorized Consumption *813.360*

Billed Authorized Consumption *804.395*

- **Billed Metered Consumption (water exported is removed)** *804.395*
- **Billed Unmetered Consumption** *0.000*

Unbilled Authorized Consumption *8.965*

- **Unbilled Metered Consumption** *4.965*
- **Unbilled Unmetered Consumption** *4.000*

Water Losses *108.162*

Apparent Losses *11.479*

- **Unauthorized Consumption** *2.304*
- **Customer Metering Inaccuracies** *8.175*
- **Systematic Data Handling Errors** *1.000*

Real Losses *96.683*

- **Leakage on Transmission and/or Distribution Mains** *Not broken down*
- **Leakage and Overflows at Utility's Storage Tanks** *Not broken down*
- **Leakage on Service Connections** *Not broken down*

Revenue Water 804.395

Non-Revenue Water (NRW) 117.127

2016 Performance Indicators

AWWA Free Water Audit Software:
System Attributes and Performance Indicators

WAS v5.0

Water Audit Report for: Security Water Districts
Reporting Year: 2016 | 12/2015 - 12/2016

*** YOUR WATER AUDIT DATA VALIDITY SCORE IS: 73 out of 100 ***

System Attributes:

	Apparent Losses:	11.479	MG/Yr
+	Real Losses:	96.683	MG/Yr
=	**Water Losses:**	**108.162**	MG/Yr
?	Unavoidable Annual Real Losses (UARL):	48.13	MG/Yr
	Annual cost of Apparent Losses:	$38,570	
	Annual cost of Real Losses:	$167,416	Valued at **Variable Production Cost**

Return to Reporting Worksheet to change this assumpiton

Performance Indicators:

Financial:	Non-revenue water as percent by volume of Water Supplied:	12.7%	
	Non-revenue water as percent by cost of operating system:	4.6%	Real Losses valued at Variable Production Cost
Operational Efficiency:	Apparent Losses per service connection per day:	4.17	gallons/connection/day
	Real Losses per service connection per day:	35.10	gallons/connection/day
	Real Losses per length of main per day*:	N/A	
	Real Losses per service connection per day per psi pressure:	0.64	gallons/connection/day/psi
	From Above, Real Losses = Current Annual Real Losses (CARL):	96.68	million gallons/year
?	Infrastructure Leakage Index (ILI) [CARL/UARL]:	2.01	

* This performance indicator applies for systems with a low service connection density of less than 32 service connections/mile of pipeline

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Water Matters!